Geophysical Research Abstracts
Vol. 18, EGU2016-10996-2, 2016
EGU General Assembly 2016

Denali in a box: analog experiments modeled after a natural setting provide insight on gentle restraining bend deformation

Anne Fendick (1), Sean Bemis (1), Kevin Toeneboehn (2), Michele Cooke (2), and Jeff Benowitz (3)

(1) University of Kentucky, Earth and Environmental Sciences, Lexington, United States (anne.fendick@uky.edu, sean.bemis@uky.edu), (2) University of Massachusetts, Department of Geosciences, Amherst, United States (toeneboehn.kevin@gmail.com, cooke@geo.umass.edu), (3) Geophysical Institute, University of Alaska Fairbanks, Fairbanks, United States (jbenowitz@alaska.edu)

Despite restraining bends along strike-slip faults creating zones of focused uplift, the relative contributions from parameters such as fault geometry and scale, obliquity, rheological contrasts, and deformation rates are not well-constrained. Similarities between simple analog models (conducted with homogenous materials) and natural restraining bend systems (typically associated with heterogeneous crust) suggest that there are first-order controls on restraining bend deformation that operate independent of heterogeneity in the upper crust. To investigate these controls we examine the Mount McKinley restraining bend (MMRB) of the Denali fault system in south-central Alaska. The MMRB is associated with an $\sim$18 degree bend in the Denali fault and exhibits strongly asymmetric topography and rock uplift. The viscous relaxation time and the ratio of crustal thickness to the restraining bend stepover distance are scaled within the analog model to that of the MMRB. We compare uplift patterns, localization of deformation, formation of new faults, and displacement fields for the model set up and the natural bend to understand the influence of different variables on the overall system to determine what controls the deformation. As shown in previous analog model studies, asymmetric topography characteristically forms with restraining bend angles of $<20°$. In our model, a continuous, through-going fault within the restraining bend accompanies a narrow zone of deformation on one side of the bend and a broader zone of deformation the opposite side. However, the active thrust faults of the MMRB are purely dip-slip, whereas the thrust faults formed in the model appear to be oblique-slip. The geometry and slip rates of active faults in the MMRB, as well as preliminary thermochronometric data, suggest that the restraining bend itself is migrating relative to previously deformed deposits. Conventional understanding of restraining bends is that fixed bends produce the highest topography while migrating bends do not allow for topography to build. The migration of the stepover segment and advection of crust through the bend in the analog model correspond with this migration, suggesting that migrating bends are of capable of producing extreme topography. This study broadens our understanding of restraining bend deformation and highlights the importance and exploitability of this type of analog modeling, such as understanding how the tallest peak in North America formed.